

Multi-site Evaluation of ESI Triage Levels and Medication Administration Times

Christy Starr, Senior Nursing Student

The Ohio State University

College of Nursing

### Abstract

**Background:** The Emergency Severity Index (ESI) is an evidence-based system of triaging patients into varying levels of acuity based on their condition to assure that a provider sees the most acute patients first. Pain is the most common reason that patients present to the Emergency Department (ED) and accounts for up to 78% of visits- meaning that the ability to recognize, classify and treat pain appropriately is very important in the ED today.

**Purpose:** The purpose of this study will be to evaluate the relationship between nurse-assigned ESI scores (a measure of triage acuity), selection of pain medication, and timeliness in pain medication administration.

**Sample:** A quantitative, retrospective study was used to study  $N = 1,966$  patients with chief complaints of pain in a large urban ED (>90,000 visits/year) in a Midwestern city and a moderate sized but busy (>60,000 visits/year) ED in a small, rural Appalachian town were combined with prospective ED conditions data collected hourly over a 3 month period in 2013.

**Procedure:** In the prospective phase, data were collected about conditions within the ED (including total ED census, number of ESI 1, 2 and 3 patients, etc.) by trained clerical staff at the beginning of each hour for 24 hours a day for three months. In the retrospective phase, patient visit data was audited from the electronic medical record and collected. Finally, the prospective and retrospective data sets were combined to match each patients' ED visit with the ED conditions data at the time of their visit.

**Results:** When the type of opioid was compared across ESI triage categories, there was a statistically significant difference in proportions of subjects receiving each medication ( $\chi^2(12) = 394.03, p < .001$ ). Subjects triaged at ESI 2 (more acute on the ESI 1-5 scale) were more likely to receive a stronger opioid – hydromorphone – than hydrocodone, for example. No statistically significant differences were noted when timeliness in pain medication administration was compared across the ESI triage categories.

**Implications for Practice:** ESI triage level corresponded well to the type of opioid administered, with lower acuity patients more often receiving hydrocodone and more acutely ill patients receiving hydromorphone. ESI triage level did not correspond with timely administration of any opioid medication, however, likely due to a “fast track” pathway where low-acuity patients are quickly treated and released. Additional research is needed to clarify the relationship between ESI triage level and timely treatment of pain in EDs.

## **Chapter I: Statement of the Problem**

### **Background of the Problem**

Pain is the most common reason that patients present to the ED, accounting for up to 78% of visits (Swales et al., 2009, p. 485). Taking this into consideration, the need for extensive evaluation of the pain medication administration system in this department becomes apparent, as patients experiencing such pain must be treated properly in order to increase overall patient outcomes and satisfaction. Timely care, as defined by the Institute of Medicine, is "reducing waits and sometimes harmful delays for both those who receive, and those who give care" (Handel et al., 2011, p. 1295). It is clear that timeliness of care for each individual patient will improve patient outcomes in the emergency setting. In addition to the fact that objective patient outcomes are improved, it is also noteworthy, as Handel et al. (2011) mentions, that "patients and families often correlate length of time spent in the ED with quality" (p. 1296).

When a patient enters the ED for pain or any other symptom, they are assessed by a triage nurse who evaluates their clinical stability and assigns a triage score to them based on how many resources the nurse anticipates that the patient will need. This measure of acuity is assessed through means such as interview, clinical evaluation of presenting symptoms, and vital signs (2009). The results of the triage nurse's evaluation are converted into an Emergency Severity Index (ESI) score that numerically conveys the overall acuity of the patient and ensures that the provider sees the more acutely ill patients first. Interestingly, van der Wulp, Rullman, Leenen & van Stel (2010) reported that pain was not associated with urgency as the ESI triage guidelines state that it is up to the discretion of the triage nurse to discern whether or not a patient's pain score is supported by his/her clinical condition, this leaving the interpretation of a patient's ESI score to the sole discretion of that triage nurse. This allows for significant subjective clinical

judgement which could cause health care disparities for patients whose pain is not considered to be a priority by the triage nurse.

The Emergency Severity Index (ESI) was initially implemented in 1999 as a means to sort patients presenting to the ED into one of five possible categories based on acuity and number of anticipated resources required (Gilboy, Tanabe, Travers & Rosenau, 2012). This algorithmic system was created to standardize the way that patients were triaged in order to provide the same quality of care across the patient population. When a triage nurse begins his or her initial meeting with a patient presenting to the ED, the nurse begins assessing the patient for stability of vital signs and level of consciousness. If the patient does not appear to meet the level 1 or 2 ESI criteria (requiring emergent or immediate treatment), the nurse begins to evaluate expected resource needs for the patient in order to determine their triage level (Gilboy et al., 2012). The ESI Implementation reduces the ESI triaging process into four key decision points that include, 'does this patient require immediate life-saving intervention?' and 'what are the patient's vital signs?' in order to quickly determine an ESI score and implement immediate interventions if necessary (Gilboy et al., 2012). Patients that arrive via Emergency Medical Services are triaged through the same process, even if they are not first seen by a triage nurse in the waiting area (Hiestand, Moseley, MacWilliams & Southwick, 2011).

Gilboy et al. (2012) noted that assigning the correct ESI score is crucial for patients because over-triage (assigning a patient to a more acute score than necessary) and under-triage (assigning a patient to an ESI score that is not acute enough) can both have dire consequences for the patient, hospital or both. Reliability of the system, however, has been found to be positive. In a 2000 study by Wuerz in which one research nurse and one investigator were asked to triage the same patients without knowledge of the others' ESI score, inter-rater reliability was found to

have 77% exact agreements and 22% within one triage level (Gilboy et al., 2011). The validity of the ESI has been extensively evaluated as well, producing studies that found a "consistent, strong correlations of the ESI with hospitalization, ED length of stay, and mortality" (Gilboy et al, 2011, p. 3).

There are many studies that focus on the assignment/accuracy of ESI scores in an ED setting but there are very few that focus on the relationship between assigned ESI scores and their influence on selection of pain medication or timeliness of administration of such medications. Ducharme et al. (2008) determined that there was a positive correlation between increased acuity and pain medication administration times but this was the only study of its kind and the results have not been validated by another similar study. According to van der Wulp et al. (2010), the mean time of patients who received analgesia to be 90 minutes, with only 29% being medicated within one hour.

There are sometimes barriers present that can prevent the Emergency healthcare team from treating patients for pain within the window of time recommended by the IOM. Bernstein et al. (2008) offers a plausible causation for the delay in analgesic medication administration time in his study, in which he cites the increasing instance of overcrowding in EDs. In instances of overcrowding, it is likely that the ESI triage scores of each patient, providing that they are not critically ill and thus immediately taken into treatment, will have a minimal effect on treatment times as there are so many patients with each ESI score that the system is unable to function effectively. This lack of space and resources is likely to lead to a large percentage of patients that become inpatient with the lengthened wait times and, although they are still experiencing high levels of pain, they leave without being seen. Bernstein et al. (2009) cites studies that show that "higher ED patient occupancy and more waiting room patients were associated with delays in

analgesia of greater than 1 hour both from triage and from room placement time" (p. 5). This information is in addition to findings that almost half of the group of patients in one study that left the ED without being seen cited "fed up with waiting" as their major reason for leaving. These findings are for cause for concern that the ESI system must be enforced and that waiting room volumes need to be decreased.

### **Purpose of the Study**

The purpose of this study was to evaluate the relationship between nurse-assigned ESI scores (a measure of triage acuity), selection of pain medication, and timeliness in pain medication administration in order to understand and improve outcomes and satisfaction of patients presenting to the ED with complaints of pain. Pain has been cited as the most frequent chief complaint for patients presenting to the ED and thus its treatment must be evaluated for efficacy and improvement methods.

### **Research Questions**

1. What is the relationship between ESI triage level and timeliness in pain medication administration? (Do patients with higher acuity levels receive pain medication more quickly than those with lower acuity levels?)
2. What is the relationship between ESI triage level and pain medication selection? (Do patients with higher acuity levels receive stronger or more doses of medication than those with lower acuity levels?)

### **Limitations**

One limitation that may have impacted this study was the presentation of a confounding variable, that is, the 'fast-track' system that is present in many EDs today. As described later in this study, the fast-track system is designed with its own assigned nurse and care provider in

order to attend to patients of lower acuity in a quick and efficient way, increasing patient turnover times (Hwang, Lipman & Kane, 2014). The addition of this system into the EDs that were studied is likely responsible for the fact that there were no statistically significant differences when timeliness in pain medication administration was compared across the ESI triage categories, as patients that are level 4 may have been seen and treated by the fast-track provider before a Level 3 patient was seen in the general ED.

## **Chapter II: Review of the Literature**

Patients often present to the ED with complaints of pain or a pain as a symptom in addition to their chief complaint. According to Swailes et al. (2009), there exists a deficiency in the amount of pain management practices in EDs today. She found that of patients who received analgesia, only 29% were medicated within 1 hour, demonstrating that patient pain management needs are not being met to a quality standard (p. 485). This proportion of patients ranges from those that are acutely ill with high amounts of pain to patients that present with pain ratings at a 1 or 2 out of a possible ten. Swaile's most pertinent findings lay in the disparities of treatment initiation amongst various patient groups. She reported that "in the pre-ESI stage, with every 10 years added to a patient's age, patients can expect their average time from triage to treatment order to decrease by 7.5%" (Swailes et al., 2009, p. 487), which may show a slight favoritism towards the older patient population. This very well may be related to the fact that older patients are typically more likely to be at risk for more serious effects of diseases that are naturally deflected by their younger counter parts.

Swailes et al. (2009) also examined the efficacy of the triage system itself, indicating that patients of level 2 acuity can expect treatment orders to be placed 39.7% faster than those of a level 3 acuity. This observation indicates that the triage hierarchy of patient acuity appears to be functioning properly, with the patients assigned to more acute ESI scores receiving treatment orders more quickly than less acute patients. One variable unable to be accounted for, however, was the fact that Swailes et al. (2009) found the time from triage to treatment for males to be "6.4% faster relative to female patients" (p. 487). This indicates a clear disparity between genders and further research on this topic may be indicated.



Ducharme et al. (2008) reiterates that "pain is the most common presenting symptom among those seeking care in the ED, emphasizing the importance of pain control in this department (p. 868). Ducharme et al. also references the 2004 Pain Policy from the American College of Emergency Physicians that states, "ED patients should receive expeditious pain management, avoiding delays such as those related to diagnostic testing or consultation" (p. 868). Ducharme et al. reveals in the same study, however, that among the 857 patients receiving opioid analgesics, "only 451 (53%) received them in less than one hour" (p. 870).

Ducharme et al. (2008) noted the need for effective pain management techniques and this door to medication administration time often relies on the triage nurse that is the first to assess the patient and assign the appropriate ESI score that should determine how quickly the patient will be receiving treatment. This study encompassed twenty EDs from across the United States as well as Canada and was conducted with the primary outcome of interest being time to administration of the initial analgesic. The end result was a total of 842 patients enrolled in the study with varying demographics, ESI scores, arrival pain scores and number of minutes spent in the ED. Of these patients, "60% (506/842) received an analgesic in the ED" (Ducharme et al., 2008, p. 870). The average time to analgesic administration amongst only patients that were ordered an analgesic medication was 90 minutes, a time frame that exceeds the 60-minute window recommended by the Policy instated by the American College of Emergency Physicians (Ducharme et al., 2008). In regards to the ability of the ESI triage system to effectively allow more acute patients to be treated first, Ducharme et al. found that "in general, shorter times were associated with higher triage levels for these systems", with "an increase of about 50 minutes from level 2 to levels 3 and 4 and then a smaller increase of about 10 minutes at level 5" (p. 870). This information appears to demonstrate that the ESI scores are being assigned correctly and that

timely and appropriate interventions are being taken into consideration based on these ESI scores.

A confounding variable that can be seen in both Ducharme et al. (2008) and the current study, however, appears to be the emergence of the 'fast-track' system that is present in many EDs today. This system was designed for ESI Level 4 or 5 score patients to be treated more rapidly in order to decrease wait times for patients with non-life-threatening injuries such as minor broken bones, sprains, strep throats, etc. The fast-track system is typically assigned its own physician or nurse practitioner and an RN and has the ability to significantly decrease treatment times for these specific patients. Ducharme et al. found that the fast-track system may have had an impact, as the median time to analgesia in minutes was virtually identical amongst the ESI-3 (median 161 minutes) and ESI-4 patients (median 160 minutes). Overall, Ducharme et al. concluded that the sites studied all demonstrated unacceptably long times to analgesic administration, an indication that further research must be done in order to make improvements to EDs nationwide.

Handel et al. (2011) summarizes findings from breakout sessions hosted at a consensus conference by *Academic Emergency Medicine* in his study. Handel et al., acknowledged that, through a 2011 review of the literature, he was able to identify a variety of ED metrics including time from arrival to triage, time from arrival to being placed in an ED bed, door to balloon time for STEMI, etc. that have been used in attempts to improve efficiency and quality of care in this department. Handel's research supports the implementation of interventions in the prehospital setting, that is calling in a report to the ED before the patient arrives in order to allow the ED staff to appropriately triage the patient and prepare the necessary healthcare team and equipment to best care for the patient upon arrival. According to Handel et al., evidence has been a strong

proponent for as prehospital data transmission (PHDT) for many serious illnesses as it has increased timeliness in care of patients with acute STEMI and, through PHDT of Electrocardiograms, it has shortened door-to-artery times. While this article does not specifically cite pain alleviation as the primary focus, it speaks volumes for the possibilities for improvement in timeliness for better patient outcomes. While no studies have quantifiably measured the relationship between PHDT and quicker response times leading to improved patient outcomes, it is clear that the transmission of this data will allow the healthcare team more time to initiate hospital protocols and actions that can certainly allow more time for life-saving measures upon arrival.

Handel et al. (2011) also analyzes the usage of a telephonic triage system that has been implemented in Midland Memorial Hospital in Texas as a possible way to reduce ED overcrowding, thus reducing patient wait times and, theoretically, decreasing door-to-medication times. This system staffs a triage phone line with RNs 24 hours a day, 7 days a week in order to direct patients either to the ED or to other health care delivery options based on hospital-determined protocols. The results of this intervention were that the hospital saw a decline in multiple ED afflictions including non-emergency patient volume in the ED, a reduction in door-to-doctor time from 30 minutes to 15-18 minutes and higher Press-Ganey patient satisfaction scores (Handel et al., 2011). Handel et al. also analyzes the implications of the introduction of new methods of triaging patients that include bedside registration as well as kiosk registration. Both methods have their advantages and disadvantages, but it appears as though the implementation of bedside registration, where patients undergo a quick, basic registration at triage and then a more detailed history of present illness at the bedside after tests and/or treatment have already been initiated, has shown an 85% reduction in triage to treatment room

time in a Cape Canaveral hospital. Kiosk systems have also been introduced in some hospitals that allow a patient to check in and undergo a triage process by the kiosk by answering specific questions related to their illness in order to streamline the triage process and alert the triage team if a patient is determined to be at a high level of risk for injury by the kiosk. If hospital systems are willing to adapt the technological advances that have started to be implemented, they have the potential to improve the triage process and decrease strain on triage staff.

### **Chapter III: Methodology**

#### **Research Design**

This study answers sub-questions from a larger, combined retrospective/prospective study in which retrospective patient-level data from medical records of patients who received one of four common opioid pain medications in the EDs of a large urban ED (>90,000 visits/year) in a Midwestern city and a moderate sized but busy (>60,000 visits/year) ED in a small, rural Appalachian town were combined with prospective ED conditions data collected hourly over a 3 month period in 2013. Patient-level data including chief complaint, ESI score, number of previous visits to the ED in the past 12 months, opioid administered and before and after pain scores and other variables were coded and entered into a spreadsheet by trained research staff and then analyzed using SPSS v 22.

#### **Population and Sample Design**

All adult patients ( $\geq 18$  years of age) who received one of four opioid pain medications (hydromorphone, morphine, hydrocodone/acetaminophen, or oxycodone – either separately or in combination with acetaminophen between 5/26/2013 and 8/26/2013 were eligible for the study. After obtaining human subjects protection approval at both study sites, an administrative dataset containing all patients meeting the above criteria was generated by the pharmacy department. Due to the large volume of patients meeting criteria, a random sample of 1200 patients from each site was selected for inclusion in the study. After excluding patients with missing *ED conditions* data, the final sample size was  $N = 1,966$  patients from across two sites.

#### **Data Collection Procedures**

There were two phases of data collection in this study. Prospectively, data were collected on variables reflecting the conditions within the ED at the top of each hour (12:00 PM, 1:00 PM,

etc.), 24 hours per day, for a period of three months. Variables of interest included the number of nurses providing direct patient care, the number of direct-care non-nurses (paramedics, nurse techs, etc.), total ED census, number of patients in waiting room, number of ESI Level 1, 2, and 3 patients in the department, number of patients awaiting inpatient beds, number of behavioral health patients, and number of medical decision makers on duty (e.g., physicians, NPs, PAs, etc.).

These data were collected by trained ED clerical staff who already collected similar, but much less, data for operational purposes. A clipboard containing a data collection sheet for each day was located centrally in the ED nursing unit where the lead clerical staff member had access. An electronic timer was affixed to the corner of the clipboard and signaled an alarm each hour of the day as a reminder to record the necessary data on the clipboard. This process was undertaken each hour, at the top of the hour, for three months. At the conclusion of the 3-month period, the data for two days were missing, likely misplaced or discarded by mistake. Thus, any patient seen on days with missing ED conditions data were excluded from final analysis. In discussions with the staff, there was no special reason data were missing from those days (e.g., very high volume of patients, disaster situation, etc.), so the data were treated as *missing at random*.

In the retrospective phase of data collection, patient-level data were collected from the medical records of the randomly selected list. Trained research assistants (who were also nursing students) collected patient-level data from electronic medical record sources. These data included age, gender, chief complaint at presentation, number of ED visits to same ED in past 12 months, ESI acuity level, time of arrival, time seen by an independent provider (from presentation to being seen by a physician/NP/PA), time of opioid medication order, time of administration of the first dose of the opioid, number of opioid doses given, pain score before dosing, pain score after

dosing, and discharge disposition (admitted, transferred, discharged). Ten percent of the study records were audited for accuracy by the PI or other member of the study team.

At the conclusion of the retrospective data collection process, the prospective and retrospective data sets were combined so that for each patient, the ED conditions data corresponding most closely to the time of their arrival in the ED were linked to their visit record. For example, when a patient presented at 12:20 AM, the 12:00 AM ED conditions data were linked to that patient's encounter. From investigator observations of ED throughput data, conditions do change from hour to hour but rarely at rates, which are thought to affect this linking strategy. It is preferable but impossible with current ED information systems to automatically capture and link ED conditions at the time of each visit, thus the strategy outlined here was employed. The final data set containing subject visit data linked with ED conditions data was analyzed using SPSS v. 22

The data are described using appropriate descriptive statistics. To evaluate the relationship between ESI triage category and timeliness in pain medication administration, Spearman's  $\rho$  correlation coefficient was calculated between the ordered ESI triage level and door-to-medication time, a continuous measure. To compare the proportions of patients across the ESI triage categories (1-5) receiving different opioid pain medications, chi square analysis for differences in proportions was used.

## **Chapter IV: Results**

### **Subjects**

Overall, the charts of  $N = 1,966$  patients were examined and included for analysis. The average age of subjects was 46.2 ( $SD = 17.4$ ) years. Subjects were 46.6% male and 53.4%

female. 77% of subjects were triaged as ESI level 3; an equal proportion, 11%, were triaged at Level 2 and Level 4. Only .6% were triaged at ESI Level 1 and .1% were triaged at ESI Level 5.

### **Research Question 1**

Data comparing median door-to-medication administration times across ESI triage categories are displayed in Figure 1. No statistically significant differences were noted when timeliness in pain medication administration was compared across the ESI triage categories ( $\chi^2 = .021, p = .341$ ). The median door-to-medication in minutes for an ESI-1 patient was 71 minutes, which was higher than patients in both ESI-2 and ESI-3 categories. This is presumed to be because patients in this category are have emergent, life-threatening conditions the treatment of which takes precedence over pain management. The median door-to-medication time for an ESI-2 patient was 66 minutes, which was 15 minutes shorter than the median time for that of an ESI-3 patient (81 minutes). In comparison across these two ESI categories, the results (although still not statistically significant), support an acuity-based treatment approach, which more acutely ill patients being treated more quickly. The most interesting result, however, may have been in the ESI-4 door-to-medication times, as they were shorter than any other ESI triage category, with a median of 63 minutes. This unexpected result may be explained by the fact that level 4 patients often qualify for treatment in ED “fast track” areas designed for low-acuity, quick visits, which both EDs in this study did utilize.



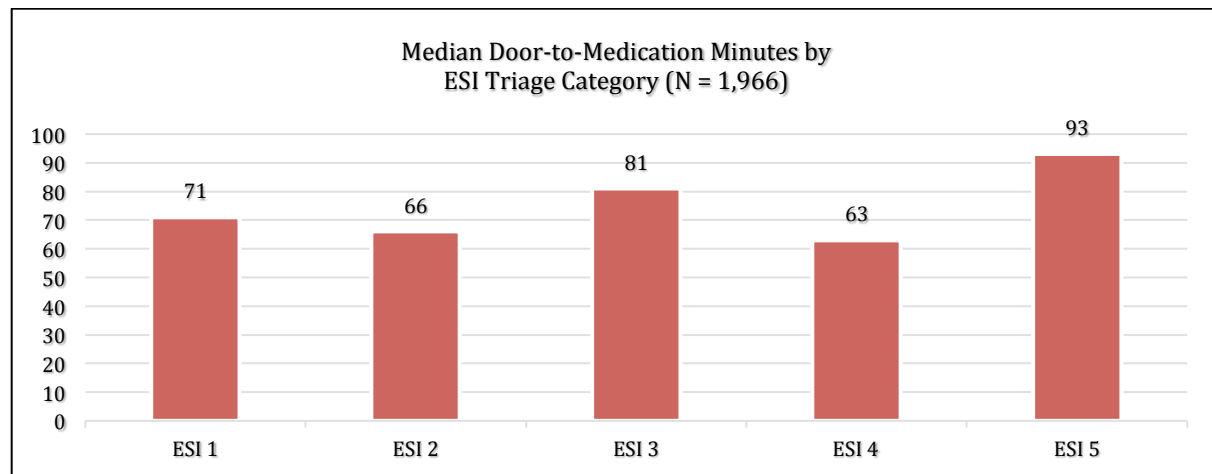
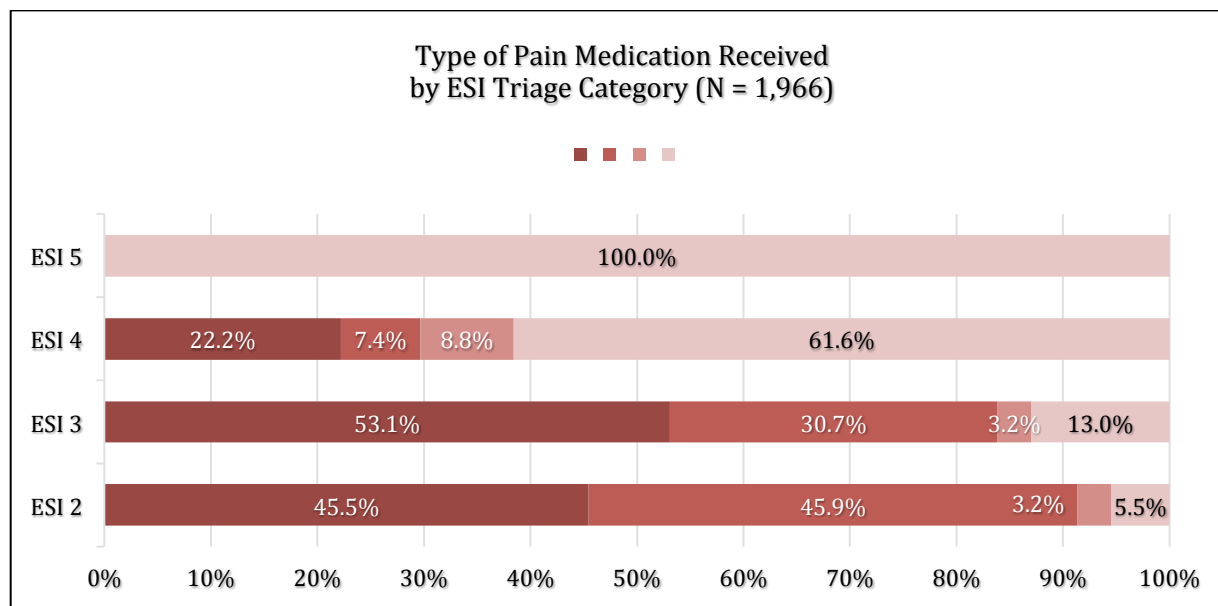


Figure 1. Median door-to-medication minutes, by ESI triage level.

## Research Question 2

Data comparing type of pain medication received across ESI triage categories are displayed in Figure 2. When the type of opioid was compared across ESI triage categories, there was a statistically significant difference in proportions of subjects receiving each medication ( $\chi^2_{(12)} = 394.03, p < .001$ ). Subjects triaged at ESI 2 (more acute on the ESI 1-5 scale) were more likely to receive a stronger opioid – hydromorphone – than hydrocodone, for example. The patients in ESI category 1 are not plotted in Figure 2 because they represented such a small proportion, with only 0.6% of overall patients triaged into this category. 45.5% of ESI-2 patients, the most acute after ESI-1, were medicated with hydromorphone, the strongest analgesic in the study and an almost identical proportion (45.9%) were medicated with morphine, the second strongest analgesic studied; hydromorphone and morphine are administered intravenously for rapid analgesia. This trend progressed downward across the triage levels of lessening acuity with increasing proportions of patients receiving hydrocodone, the weakest of the analgesics. This proportion of patients receiving hydromorphone begins in ESI-2 as 5.5% of patients, then 13.0% in ESI-3 and 61.6% and 100.0% for ESIs 4 and 5, respectively. These data strongly indicate that

the type of pain medication received is consistent with the acuity indicated by the ESI score assigned at triage; thus, the ESI system is functioning as intended in this aspect.



*Figure 2.* Proportion of opioids administered in each ESI acuity category.

## **Chapter V: Conclusions and Recommendations**

This study provides an insight into the functionality of the ESI triaging system as well as by examining the extent to which ESI triage level corresponded with timeliness in opioid analgesic medication administration and the type of medication used. The implications of this study are two-fold. First, the study indicates that some aspects of the ESI triage system are functioning in a way consistent with the design of the system. In this study, patients with higher acuity ratings received stronger opioid medications, consistent with the goals of an acuity-based triage model where more acutely ill patients are treated first. This also indicates that the ESI system, which is designed to predict the number of anticipated resources (such as tests, medications, and treatments) the patient will need while in the ED, is assigning resources appropriately.

Secondly, ESI triage level did not reliably predict timeliness in medication administration. One might expect that door-to-medication times should increase with increasing ESI scores (i.e., an ESI-5 patient should have a longer door-to-medication time than an ESI-2 patient), but this was not the case. While most ESI categories did meet the 90-minute door-to-medication goal, ESI-5 patients waited a median 93 minutes. In addition, ESI-3 patients waited a median time of 81 minutes, close to the 90 minute mark. Further research is needed on “fast track” treatment models and how they impact the timeliness of care delivered in other parts of the same ED. Additional confounding factors, such as increasing patient volumes in the main ED at the time of day when fast track treatment areas open, should also be examined. These are dynamic factors which are difficult to measure but likely play a role in providing timely analgesic treatment to patients with pain.

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